Knowledge innovation of tourism and hospitality department teachers on student creative self-efficacy and innovation behaviors: Using hierarchical linear modeling

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ABSTRACT

This study aims to explore how tourism and hospitality department promote the influence of teachers knowledge innovation on students creative self-efficacy and innovation behaviors. Taking teachers and students in tourism and hospitality departments of 30 universities and colleges in Taiwan as subjects, this study investigated 2 teachers and 15 students in every university with collected valid questionnaire including 43 teachers and 379 students and analyzed by hierarchical linear modeling. It is found that students creative self-efficacy has significantly positive influence on innovation behaviors but university and college promoting teachers knowledge innovation has no significant influence on students innovation behaviors. In terms of moderation effect of teachers’ knowledge innovation, knowledge application of knowledge innovation has positive moderation effect on students’ creative self-efficacy and students’ innovation behaviors. Knowledge generation has negative moderation effect on students’ creative self-efficacy and students innovation behaviors. Hence, under the interaction of teachers’ knowledge innovation and students creative self-efficacy, teachers’ knowledge generation and knowledge application have separately generated negative and positive moderation effect on students’ innovation behaviors. Therefore, university and college should value and increase students’ innovation self-behaviors and properly plan teachers’ knowledge innovation to help students on innovation behaviors performance and development.

Keywords: Knowledge innovation, creative self-efficacy, innovation behavior.

INTRODUCTION

Tourism industry has gained increased prominence in Taiwan’s economic development as the country opens access to foreign visitors and the lifestyle of Taiwanese citizens changes. The number of tourists who visited Taiwan in 2014 reached 9,906,201, a growth of approximately 24% as compared with that in 2013. In addition, visitor expenditure amounted to NT$437 billion (Taiwan Tourist Hotel Association, 2015). As tourism industry develops human resource quality and training programs have become the key factor in the development of tourism and hospitality industry. Subsequently, universities and colleges nationwide have established tourism and hospitality (hereafter referred to as “T and H”) departments, and the number of students enrolled in such department has constantly increased.

According to the Ministry of Education Republic of China (2015), the top three departments with the most substantial growth in number of students for the academic years 2009 to 2014 included hospitality, food and beverage management, and tourism, demonstrating, in total, an increase of 20,460 in number of students. However, the establishment of T and H department has intensified competition among schools. All competing schools have used innovative approaches to seek uniqueness and attract students enrollment. Consequently, the development of T and H departments is oriented towards innovation and
cultivation of students with innovation capability.

Drucker (2002) indicated that continual innovation is the fundamental requirement for the survival of an organization. In a complex, competitive environment, innovation is pivotal to organizations seeking sustainability (Kearney et al., 2009). Organizations must build knowledge-based innovation capability, and this knowledge innovation is the principal factor influencing whether the organization can sustain its competitive advantages (Barney, 1991).

Knowledge innovation enables the organization to successfully make adjustments and survive in a constantly changing environment. Hence, practitioners have placed their attention on knowledge innovation (Bell, 2005; Emsky, 2005; Muthusamy et al., 2005). Knowledge innovation helps schools to overcome external challenges (Hsiao, 2008; Tseng et al., 2005) and pursue sustainable development. Teachers are the main promoters of knowledge innovation, as well as, the source of emanation of knowledge innovation. They share and apply their own knowledge and externally acquired knowledge to their organization and in class. Therefore, the present study adopted teachers' knowledge innovation as a main research variable.

Schools provide the ground to inspire and cultivate students' knowledge and innovation capabilities (Wu and Huang, 2002). Schools also aggressively foster students with innovation capability, which help students respond to future employment challenges. Gong et al. (2009) studied innovation behavior and found that creative self-efficacy directly predicts innovation behavior (Jaussi et al., 2007; Tierney and Farmer, 2002). Creative self-efficacy refers to individuals' belief in their ability to produce creative work (Tierney and Farmer, 2002). This finding inspired the present study to investigate whether the creative self-efficacy of students from T and H department influences students' innovation behavior.

Bandura (1977) integrated concepts of cognition theory and social learning to propose social learning theory, which elucidates human behavior according to the interactions and influences among a person's personality, behavior and environment. Individual learning occurs through observation and imitation and learning behavior differs according to environmental influence. Factor of social learning at the individual level is self-efficacy. The variables examined in the present study were teachers' knowledge innovation, student creative self-efficacy, and student innovation behavior. Therefore, the present study adopted social learning theory as the research framework, creative self-efficacy and innovation behaviors as individual and behavioral constructs of individual-level factors, and teachers' knowledge innovation as environmental factor. Subsequently, this study explored the relationships among the research framework, factors at the individual level, environmental factors and examined the moderating effect of teachers' knowledge innovation on students' creative self-efficacy and innovation behaviors in order to ascertain and verify the effectiveness of knowledge innovation-related activities in improving the performance of students' innovation behavior under the influence of their creative self-efficacy.

Furthermore, teachers and students are concepts at different levels, but the approaches to analyzing innovation topics are largely on a single level (Ostroff and Bowen, 2000). Therefore, the present study adopted multilevel perspectives to conduct investigations, using hierarchical linear modeling (HLM) for data analysis to elucidate the current status regarding the effects of T and H departments in promoting teachers' knowledge innovation, examining the effects of students' creative self-efficacy on their innovation behavior and contributing towards studies on student innovation behaviors.

This study investigated the effect that knowledge innovation in teachers of T and H departments has on students' creative self-efficacy and innovation behaviors. In addition, the moderating effect of teachers' knowledge innovation was examined. HLM was subsequently employed for multilevel analysis. The objectives of this study are as follows:

1) To investigate the effects of students' creative self-efficacy on their innovation behaviors;
2) To investigate the effects of teachers' knowledge innovation on students' innovation behaviors;
3) To investigate the effects of teachers' knowledge innovation on students' creative self-efficacy;
4) To investigate whether teachers' knowledge innovation moderates the relationship between students' creative self-efficacy and their innovation behaviors; and
5) To provide valuable references for T and H departments and subsequent scholars according to discussions and recommendations based on the results of this study.

LITERATURE REVIEW

Creative self-efficacy and innovation behavior

According to Kanter (1988), innovation is related to idea generation and idea realization. Innovation behavior is composed of four stages: solutions and adoptions of innovation ideas generated; innovator seeking assistance for the generated idea; and innovator taking action to realize the idea. Scott and Burce (1994) also proposed three dimensions of innovation behavior: idea generation, idea promotion and idea realization. However, individual innovation behavior is not confined to the technological changes; it comprises creativity, implementation process and innovation behavior (West and Anderson, 1996).

Jong and Hartog (2007) viewed innovation behavior as multidimensional, with its core concept being the behaviors generated during the procedure through which employees engage in innovation. At the beginning,
loopholes or problems occur at the implementation level, in which employees seek opportunities and generate ideas. At the application stage, employees play a critical behavioral role and at the innovation stage, employees engage in behaviors that aim at idea verification. For this reason, innovation behavior is the key to organizational innovation and also a crucial element of organizational innovative development. Therefore, innovation behavior involves learners generating innovative ideas and problem solutions during innovation activities through which they demonstrate the ability to practice innovation.

Regarding creative self-efficacy, Bandura (1977) developed the self-efficacy concept, defining it as learners' belief in themselves to achieve success. This belief is founded on their self-assessment of whether they are capable of completing a behavior. However, although general self-efficacy is positively related to individual creative self-efficacy, it cannot be analogized to measures of self-efficacy in different domains (Chen et al., 2001; Tierney and Farmer, 2002).

Consequently, Tierney and Farmer (2002) defined creative self-efficacy as a person's belief that he/she is capable of producing creative works. Tierney also found that creative self-efficacy can directly elicit innovation behavior, and these two factors both influence individual creativity. Hence, creative self-efficacy is also the principal determinant of innovation behavior.

Bandura (1997) asserted that high-level self-efficacy is the pre-requisite for creativity and new knowledge discovery; it motivates individuals to be creative and also influences their future innovation behavior and performance (Ford, 1996). Creative self-efficacy studies have also determined that creative self-efficacy effectively predicts individual innovation behavior and performance (Gong et al., 2009; Tierney and Farmer, 2002), and that students' creative self-efficacy plays a pivotal role in their innovation behavior and performance (Chang and Yang, 2012; Cheng et al., 2012; Huang and Hung, 2009). Therefore, a high level of creative self-efficacy represents enhanced innovation behavior. This study proposes the following hypothesis:

\[ H_1: \text{Student creative self-efficacy positively significantly influences innovation behavior.} \]

### Knowledge innovation and innovation behavior

Knowledge is characterized by transferability, capacity for aggregation, appropriability, specialization in knowledge acquisition and knowledge requirements of production. Organizations can create value through knowledge; therefore, knowledge can be transferred, converted, shared, applied and stored to achieve efficient knowledge creation and innovation (Grant, 1996). In addition, Nonake and Takeuchi (1995) claimed that knowledge creation and innovation are derived from an interaction and conversion between implicit and explicit knowledge.

Knowledge innovation is predominantly based on personal experience and intuitive implicit knowledge; it occurs through interpersonal interactions. The accumulation and absorption of knowledge capital are the foundations of knowledge innovation. Consequently, the level of knowledge capital transferred within an organization influences individual knowledge innovation.

Regarding knowledge innovation, Shen and Li (2008) identified that knowledge innovation enhances an organization's innovation capability to an extent that the organization can sustain its competitive advantage. In reference to studies conducted by Damanpour and Evan (1984), Tidd et al. (2001), Higgins (1995) and Shen and Li (2008) further classified knowledge innovation into product innovation, process innovation, management innovation and market innovation. Tseng et al. (2005) conducted a study on feasible strategies for knowledge innovation in elementary schools; Tseng et al. (2005) found that adequate knowledge, benchmark learning, topic discussion, ability to act according to circumstances and capability to integrate new and old experiences positively influence teachers’ knowledge innovation. Moreover, activities teachers undertake at school are knowledge-based. If they can effectively engage in knowledge-based innovation, then, they can determine the trends of knowledge and foster students with creative thinking and problem-solving skills.

Wang (2002) also reported that knowledge innovation benefits teaching quality at schools, establishes teaching effectiveness and improves students’ learning performance and creative performance. Teachers’ knowledge innovation primarily involves nurturing students’ future capabilities. In knowledge innovation, teachers can summarize, analyze and organize teaching materials; integrate teaching scenarios with teaching strategies and combine innovative and creative teaching methods and materials. In doing so, they can help students to improve their knowledge on innovation and innovation capability (Wang, 2002; Lin, 2000). This study proposes the following hypothesis:

\[ H_2: \text{Teachers’ knowledge innovation positively significantly influences students’ innovation behavior.} \]

### Knowledge innovation, creative self-efficacy and innovation behavior

Bandura (1986) proposed the social learning theory, positing that a person is influenced by the environment and has the cognitive ability to actively select and influence the environment; that behavior is influenced by the environment but behavioral outcome also changes the environment; and that individual cognition influences behavior but is also subjected to the influence of...
behavioral outcome. In addition, human behavior is explained by using the interactive and influential relationship among behavior, personal factors and environmental factors (Bandura, 1986; Hunter et al., 2007). Members of an organization tend to exhibit greater motivation and cognition to engage in innovation activities when they subjectively perceive that the environment in which they reside emits positive climate for innovation and that their organization supports and encourages innovation behavior. Members with such perception tend to achieve innovation performance (Amabile et al., 1996; Baer and Frese, 2003; Kark and Carmeli, 2009).

Wu and Huang (2002) reported that schools do not only disseminate knowledge but also create knowledge. When knowledge recipient has a high level of self-efficacy in an organization, knowledge innovation in the organization is more effective. If students can learn in an environment where innovative thinking is encouraged and supported and where support from significant others is received, then students can demonstrate improved innovation capability (Csikszentmihalyi, 1999; Mayer, 1999). Individual creative self-efficacy is prone to influence from new school technologies and facilities (Aliakbari, 2015); moreover, Beghetto (2006) verified the effect of teachers and teaching environment on students’ creative self-efficacy. The aforementioned results show that if school teachers share their knowledge innovation experiences in class, then it will help students to improve their creative self-efficacy. This study proposes the following hypothesis:

\[ H_3: \text{Teachers' knowledge innovation positively influences students' creative self-efficacy.} \]

Hsu and Fan (2006) suggested combining individual positive perception toward organizational context and innovation vitality toward individual confidence in innovation because, together, they can explain members’ innovation behavior. Bammens (2015) found that an innovation-supporting organizational environment and employee motivation crucially influence employees’ innovation behavior. Numerous scholars have maintained investigating individual creativity and innovation capability from environmental perspective. In particularly, interaction between the environment and individual cognition exerts an influence on individual creativity and innovation capability (Amabile, et al., 1996; Csikszentmihalyi, 1999; Simonton, 1997; Hunter, et al., 2007; Bammens, 2015). Individual innovation behavior is exposed to the interactive effect between the environment and creative self-efficacy (Tierney and Farmer, 2002). In an environment where innovation is supported, employees exhibit higher creative self-efficacy and thereby show better innovation behavior (Jaiswal and Dhar, 2015). School climate for innovation influences students’ creative self-efficacy and innovation behaviors (Chang and Yang, 2012), indicating that distinct innovation environment in schools and students’ level of cognition regarding innovation generate an effect on students’ capability to innovate. The present study infers that teachers’ knowledge innovation (a factor of school environment) and its interaction with students’ creative self-efficacy exert an influence on students’ innovation behavior. For example, when teachers teach by transferring and sharing their new knowledge, which would boost students’ confidence in their creative ideas and creations, students would be more motivated to engage in innovation behaviors. This study proposes the following hypothesis:

\[ H_4: \text{Teachers’ knowledge innovation moderates the relationship between students' creative self-efficacy and innovation behaviors.} \]

\[ H_{4.1}: \text{Teachers’ organization situation moderates the relationship between students' creative self-efficacy and innovation behaviors.} \]

\[ H_{4.2}: \text{Teachers’ knowledge production moderates the relationship between students' creative self-efficacy and innovation behaviors.} \]

\[ H_{4.3}: \text{Teachers’ knowledge application moderates the relationship between students' creative self-efficacy and innovation behaviors.} \]

\[ H_{4.4}: \text{Teachers’ knowledge dissemination moderates the relationship between students' creative self-efficacy and innovation behaviors.} \]

**RESEARCH METHODS**

**Research framework**

With the social learning theory as the research framework, this study adopted HLM for analysis, using teachers’ knowledge innovation as the environmental factor at the teacher level and student creative self-efficacy as individual and behavioral factors, respectively, at the student level. This structure forms the study’s research framework as shown in Figure 1.

**Questionnaire design and sampling**

This study investigated the relationship of teachers’ knowledge innovation with student creative self-efficacy and innovation behavior, focusing on T&H department teachers and students as the research subjects. Regarding teachers, knowledge innovation scale was used to elucidate the implementation outcomes of knowledge innovation in T and H departments. The Organizational Knowledge Innovation Scale developed by Hsiao (2008) was adopted. Five T and H expert scholars were invited to revise the scale before the scale dimensions and items were evaluated. The four dimensions of the scale (that is, organizational situation, knowledge production, knowledge application and
knowledge dissemination) were revised such that they contained a total of 78 items.

Regarding students, the Scale of Creative Self-efficacy for Students (Huang and Hung, 2009) and Innovation Behavior Scale (Kleysen and Street, 2001) were used. The dimensions of the creative self-efficacy scale (that is, creative thinking, belief in creative production and resistance against negative evaluations) were revised, yielding 12 items. The innovation behavior scale composed of opportunity exploration, generativity, formative investigation, championing and application and contained 14 items in total.

Purposive sampling approach was employed to sample two teachers and 15 students each from the T and H departments of 30 college schools across Taiwan. The questionnaires were distributed only after teacher consent was obtained. In total, questionnaires were delivered to 60 teachers and 450 students, from which 43 and 379 valid questionnaires were returned, respectively.

Research instrument

The research instruments applied in this study included a knowledge innovation scale, creative self-efficacy scale and innovation behavior scale. In addition, exploratory factor analysis (EFA) and reliability analysis were used to conduct a pretest on the scales; subsequently, confirmatory factor analysis (CFA) was performed on the official scales to measure the construct validity and goodness of fit of the scales used.

Knowledge innovation

Knowledge innovation was composed of four dimensions: organizational situation, knowledge production, knowledge application and knowledge dissemination. Organizational situation items that do not meet reliability standards were deleted, including items 8, 9 and 21. The Cronbach’s α of organizational situation was 0.924, and the Cronbach’s α values of various factors under this dimension were all greater than 0.7, exceeding the standard recommended by Nunnally (1978). The Cronbach’s α of knowledge production was 0.948 and the Cronbach’s α values of various factors under this dimension were all greater than 0.7. Items 1 and 9 of knowledge application did not meet the reliability standard and were therefore eliminated; the Cronbach’s α of this dimension was 0.961. Items 11, 12 and 13 of knowledge dissemination did not meet the reliability standard and were therefore eliminated; the Cronbach’s α of this dimension was 0.947, and the Cronbach’s α values of various factors under this dimension were all greater than 0.7.

This study adopted CFA to examine the degree of fit of the scale. The results indicated that except for root mean square residual (RMR=0.084>0.05), standardized RMR (SRMR=0.063>0.05), root mean square error of approximation (RMSEA=0.09>0.08), and normed chi-square (NC=4.7>3) were all relatively acceptable, the remaining indices met the evaluation standards (goodness of fit index [GFI]=0.89>0.80, adjusted goodness of fit index [AGFI]=0.82>0.80, parsimony normed fit index [PNFI]=0.66>0.50, parsimony goodness of fit index [PGFI]=0.56>0.50, normed fit index [NFI]=0.90>0.90, non-normed fit index [NNFI]=0.90>0.90, comparative fit index [CFI]=0.90>0.90, and incremental fit index [IFI]=0.91>0.90). The factor loadings of each dimension and item ranged between 0.65 and 0.89, fulfilling the standard of fit (Bagozzi and Yi, 1988).

Creative self-efficacy

EFA was performed, yielding Kaiser- Meyer-Olkin (KMO) value of 0.848 with cumulative Explained Variance of 53.322%. Items 10 and 12 were deleted because their Average Variance Extracted (AVE) values were less than 0.5. Next, second EFA was performed, yielding KMO of 0.841 with a cumulative Explained Variance of 58.951%. AVE values were greater than 0.5 and factor loadings were greater than 0.6. Subsequently, creative self-efficacy was divided into three dimensions: (a) Creative thinking (Items 1, 2, 3, and 9); (b) belief in creative production (Items 4, 5, 6, and 7); and (c) resistance against negative evaluations (Items 8 and 11). In terms of reliability, the Cronbach’s α of

Figure 1: Research framework.
Creative self-efficacy was 0.756; the Cronbach’s α values of the three dimensions were 0.709, 0.775, and 0.688, respectively.

The creative self-efficacy scale was then examined using CFA. In terms of absolute fit indices, GFI=0.95>0.80, AGFI=0.91>0.80, RMR=0.045<0.05, SRMR=0.048<0.05, and RMSEA=0.076<0.08. In terms of parsimony fit indices, NC=2.179<3, PNFI=0.68>0.50, and PGFI=0.55>0.50. In terms of incremental fit indices, NFI=0.96>0.90, NNFI=0.97>0.90, and IFI=0.97>0.90. These results indicate that the indices of creative self-efficacy scale fulfilled evaluation standard. The factor loadings of each dimension and item ranged between 0.64 and 0.76, fulfilling the standard of fit (Bagozzi and Yi, 1988).

**Innovation behavior**

Regarding innovation behavior, EFA was performed, yielding KMO value of 0.896 with cumulative explained variance of 53.393%. Items 13 and 14 were deleted because their AVE values were less than 0.5. Next, second EFA was performed, yielding KMO of 0.888 with a cumulative explained variance of 54.766%. AVE values were greater than 0.4 and factor loadings were greater than 0.6. Subsequently, innovation behavior (Items 3, 4, and 5) was further branched into three dimensions: (a) motivation to innovate (Items 6, 7, and 8); (b) innovation application (Items 1, 2, and 9); and (c) searching and identification (Items 10, 11 and 12). In terms of reliability, the Cronbach’s α of innovation behavior was 0.841; the Cronbach’s α values of the remaining three dimensions were 0.793, 0.686 and 0.664, respectively.

The innovation behavior scale was then examined using CFA. Except for RMR, SRMR, RMSEA, and NC, which were all relatively acceptable (RMR=0.072>0.05, SRMR=0.055>0.05, RMSEA=0.083>0.08, and NC=4.5>3), the remaining indices satisfied the evaluation standard (GFI=0.91>0.80, AGFI=0.86>0.80, PNFI=0.711>0.50, PGFI=0.583>0.50, NFI=0.94>0.90, NNFI=0.93>0.90, CFI=0.95>0.90, and IFI=0.95>0.90), indicating that the indices fell within the acceptable range. The factor loadings of each dimension and item ranged between 0.55 and 0.82, fulfilling the standard of fit.

**RESULTS AND DISCUSSION**

For this study, 43 and 370 valid questionnaires were returned from teachers and students, respectively. Regarding the demographics of teachers, there were 22 male teachers and 21 female teachers. Their age was in the ranges of ≤29 years (n=1); 30 to 39 years (n=10); 40 to 49 years (n=19); and 50 to 59 years (n=13). The teachers had completed bachelor’s degree (n=1), masters (n=16), and doctorate (n=26) and attended general universities (n=11), university of science and technology (n=25), vocational schools (n=6), institute of technology (n=1). There were 13 vocational and technical teachers and 30 full-time teachers. The teachers had different years of experience in teaching, including ≤5 years (n=16), 6 to 10 years (n=8), 11 to 15 years (n=10), 16 to 20 years (n=3), and 21 to 25 years (n=6).

This study adopted HLP to analyze the proposed hypotheses and investigate the relationship of teachers’ knowledge innovation with students’ creative self-efficacy and innovation behaviors. Before HLM was performed, within-group consistency (Klein and Kozlowski, 2000) and difference in between-group variance (James et al., 1993) among the contextual variables of this study must be determined.

**Null model**

During HLM, null model must be used to examine the presence or absence of multilevel effects before slope-as-outcomes and intercept-as-outcomes analysis can be conducted. When intra-class correlation (ICC) value is greater than 0.059 (Wen, 2006) and ICC2 is greater than 0.50 (James et al., 1993), between-group variance exhibits significant difference. Subsequently, multilevel statistical analysis must be considered. This study adopted creative self-efficacy and innovation behavior as the dependent variables; therefore, null model analysis was performed first.

**Innovation behavior**

Between-group variance component value was 0.012, achieving significant level (χ^2=52.808, df=29). Within-group variance component value was 0.187, satisfying the requirement of HLM analysis regarding between-group and within-group variation of dependent variables (Gavin and Hofmann, 2002). ICC was 0.012/(0.012+0.187)=0.061 and ICC2 was 0.518. Only 6.1% of the variation emanated from school level, whereas the remaining 93.9% of variation was attributed to students.

**Creative self-efficacy**

Between-group variance component value was 0.012, achieving significant level (χ^2=50.445, df=29). Within-group variance component value was 0.200, satisfying the requirement of HLM analysis regarding between-group and within-group variation of dependent variables (Gavin and Hofmann, 2002). ICC was 0.012/(0.012+0.200)=0.057 and ICC2 was 0.511. Only 5.7% of the variation in students’ creative self-efficacy was attributed to different teachers, and this result achieved significant level. In other words,
students who are taught by different teachers exhibited distinct creative self-efficacy.

Random-coefficients regression model

Effect of student creative self-efficacy on innovation behavior

According to the random effect model shown in Table 2, creative self-efficacy achieved significant level ($γ_{10}=0.562$, $se=0.039$, $t=14.488$, $p<0.001$), indicating that students' creative self-efficacy positively significantly influences their innovation behavior and that this variable is an effective predictor of innovation behavior. Thus, $H_1$ was supported.

Table 2: Summary of the moderating effect of teachers' knowledge innovation.

<table>
<thead>
<tr>
<th>Model</th>
<th>Random prediction model</th>
<th>Intercept-as-outcomes model</th>
<th>Slope-as-outcomes model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed model</td>
<td>Coefficient</td>
<td>t</td>
<td>Coefficient</td>
</tr>
<tr>
<td>$γ_{00}$</td>
<td>1.786</td>
<td>12.938***</td>
<td>1.635</td>
</tr>
<tr>
<td>Organizational situation $γ_{01}$</td>
<td>0.095</td>
<td>1.179</td>
<td>-0.192</td>
</tr>
<tr>
<td>Knowledge production $γ_{02}$</td>
<td>-0.010</td>
<td>-0.133</td>
<td>1.019</td>
</tr>
<tr>
<td>Knowledge application $γ_{03}$</td>
<td>0.010</td>
<td>0.230</td>
<td>-0.722</td>
</tr>
<tr>
<td>Knowledge dissemination $γ_{04}$</td>
<td>-0.062</td>
<td>-1.342</td>
<td>0.040</td>
</tr>
<tr>
<td>Creative self-efficacy $γ_{10}$</td>
<td>0.562</td>
<td>14.488***</td>
<td>0.567</td>
</tr>
<tr>
<td>Organization situation*</td>
<td>0.076</td>
<td>0.503</td>
<td>-0.288</td>
</tr>
<tr>
<td>Creative self-efficacy $γ_{11}$</td>
<td>0.076</td>
<td>0.503</td>
<td>-0.288</td>
</tr>
<tr>
<td>Knowledge production*</td>
<td>0.212</td>
<td>2.271*</td>
<td>0.030</td>
</tr>
<tr>
<td>Creative self-efficacy $γ_{12}$</td>
<td>0.076</td>
<td>0.503</td>
<td>-0.288</td>
</tr>
<tr>
<td>Knowledge application*</td>
<td>0.212</td>
<td>2.271*</td>
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<td>0.076</td>
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<td>Knowledge dissemination*</td>
<td>0.212</td>
<td>2.271*</td>
<td>0.030</td>
</tr>
<tr>
<td>Creative self-efficacy $γ_{14}$</td>
<td>0.076</td>
<td>0.503</td>
<td>-0.288</td>
</tr>
<tr>
<td>Random effect</td>
<td>Variance</td>
<td>$X^2$</td>
<td>Variance</td>
</tr>
<tr>
<td>$τ_{00}$</td>
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<td>23.686</td>
<td>0.006</td>
</tr>
<tr>
<td>$σ^2$</td>
<td>0.127</td>
<td>0.127</td>
<td>0.127</td>
</tr>
</tbody>
</table>

Effect of teachers' knowledge innovation and students' innovation behavior

Table 1 shows that the dimensions under teachers' knowledge innovation, namely organizational situation ($γ_{01}=0.046$, $se=0.122$, $t=0.375$, $p>0.05$), knowledge production ($γ_{02}=-0.111$, $se=0.125$, $t=-0.892$, $p>0.05$),
knowledge application ($\gamma_{03}=-0.176$, se=0.082, t=-2.152, p<0.05), and knowledge dissemination ($\gamma_{04}=0.007$, se=0.106, t=0.068, p>0.05), did not achieve significant level. This result indicates that knowledge innovation exerted no significant influence on students' innovation behavior. Thus, $H_2$ was not supported.

**Effect of teachers' knowledge innovation and students' creative self-efficacy**

Table 1 shows that knowledge production ($\gamma_{02}=-0.028$, se=0.089, t=0.318, p>0.05), and knowledge dissemination ($\gamma_{04}=0.007$, se=0.106, t=0.068, p>0.05), did not achieve significant level. These results suggest that knowledge production negatively influences students' creative self-efficacy. Therefore, $H_3$ was not supported.

**Slope-as-outcomes model**

Slope-as-outcomes model shown in Table 2 revealed that knowledge production under knowledge innovation exerts negative moderating effect on the relationship between students' creative self-efficacy and innovation behavior ($\gamma_{12}=-0.288$, se=0.133, t=-2.163, p<0.05). Moreover, Figure 2 shows that when the level of teachers' knowledge production is high, students tend to exhibit a high level of creative self-efficacy but seldom engage in innovation behavior. However, when the level of teachers' knowledge production is low, students not only exhibit a high level of creative self-efficacy but also actively engage in innovation behavior.

Knowledge application under knowledge innovation exerts positive moderating effect on the relationship between students' creative self-efficacy and innovation behavior ($\gamma_{13}=0.212$, se=0.093, t=2.271, p<0.05). Figure 3 shows that when the level of teachers' knowledge application is high and students exhibit a high level of creative self-efficacy, students are motivated to engage in innovation behavior. Conversely, when the level of teachers' knowledge application is low, students exhibit a high level of creative self-efficacy and seldom engage in innovation behavior.

Organizational situation ($\gamma_{11}=0.076$, se=0.150, t=0.503, p>0.05) and knowledge dissemination ($\gamma_{14}=-0.030$, se=0.080, t=-0.373, p>0.05) exerted no significant moderating effect on the relationship between students' creative self-efficacy and innovation behavior. Therefore, $H_{4-2}$ and $H_{4-3}$ were supported, and $H_{4-1}$ and $H_{4-4}$ were not supported.

In light of the rapid growth and changes in the T and H industry, schools respond by using innovative approaches to changing their environment, establishing department characteristics, strengthening teacher innovation capability, and fostering student innovation capacity. Therefore, this study investigated the relationship that the knowledge innovation of T and H department teachers has with
students’ creative self-efficacy and innovation behavior. Finally, conclusion and recommendations were drawn on the basis of the study results.

Conclusion

Student creative self-efficacy positively influences innovation behavior

Students’ creative self-efficacy generated a positive effect on their innovation behavior; this result accords with that of Tierney and Farmer (2002), who found that if students perceive their ability to undergo creative thinking, produce creative works, accept challenges and resist negative evaluations, then, they will perform better in terms of innovation motivation, application and behavior. Conversely, if students deem themselves as being incapable of generating creative ideas, producing creative works and tolerating criticisms, then, they are unlikely to engage in innovation behavior. Therefore, attention must be paid to students’ creative self-efficacy in order to motivate or cultivate innovation behavior in students.

Teachers’ knowledge innovation exerts no influence on students’ innovation behavior

Implementing knowledge innovation practice at school posed no tangible benefit on students’ innovation behavior. In other words, despite schools’ effort in improving teachers’ knowledge innovation capabilities with regards to organizational situation, knowledge production, knowledge application and knowledge dissemination, it exerts no direct positive effect on students’ innovation behavior. Further exploring the reason underlying this result reveals that the teachers were not satisfied with the practice of knowledge innovation, producing satisfaction scores of 3 to 3.5 on average. Consequently, students cannot distinguish the difference in knowledge innovation-based teaching and therefore, knowledge innovation exerted no influence on students.

Teachers’ knowledge production during knowledge innovation negatively influences students’ creative self-efficacy

When teachers engage in high level of knowledge production, students exhibit low level of creative self-efficacy. The result is probably attributed to the emphasis on T and H department places on innovative knowledge generation. To actively acquire and create new knowledge, teachers tend to neglect students’ creativity development. As a result, students lose confidence in their creativity. However, when teachers’ knowledge production is low, teachers tend to have time to guide and assist students, allowing students to have confidence in their creative skills.

Teachers’ knowledge production negatively moderates the relationship between students’ creative self-efficacy and innovation behavior

The interaction between teachers’ knowledge production and students’ creative self-efficacy negatively influences
Students' innovation behavior. In other words, when teachers acquire and create new knowledge frequently, students generally exhibit poor performance in innovation behavior despite their confidence in generating creative ideas, producing creative works and accepting criticisms. This result is probably attributed to teachers spending too much time on producing innovative knowledge rather than on guiding students. Consequently, students who initially demonstrated high level of creative self-efficacy gradually presented poor performance in innovation behavior.

**Teachers' knowledge application positively moderates the relationship between students' creative self-efficacy and innovation behavior**

A high level of knowledge application by teachers and a high level of creative self-efficacy in students strengthen students' innovation behavior performance. This phenomenon is as a result of teachers applying knowledge innovation (by knowledge transfer and evaluation, etc) in teaching, which leads to the creation of an environment where innovative teaching is provided and development of an innovative teaching approach. In addition, this teaching practice imparts greater confidence in students regarding their ability to produce creative ideas, complete creative works, and tolerate criticisms. Subsequently, students are motivated to engage in innovation behaviors. Thus, when students hold beliefs about their creative skills, teachers' knowledge application is conducive to evoking students' innovation behavior. Furthermore, if teachers can apply innovative knowledge in teaching, it will effectively encourage innovation behaviors in students.

**Recommendations**

**Underlining the importance of students' creative self-efficacy**

The findings of this study revealed that students' creative self-efficacy positively affects their innovation behavior. In terms of moderating effect, creative self-efficacy promotes innovation behavior. Therefore, students' creative self-efficacy should be targeted when cultivating and enhancing their innovation behavior. Moreover, subsequent scholars can view creative self-efficacy as a crucial influencing variable when investigating the creativity or innovation behaviors of T and H department students. Schools should properly plan knowledge innovation related operations for teachers; schools promote teacher knowledge innovation to provide new insights for teachers and improve teachers' new professional knowledge and skills so that they can apply them in teaching. However, study results revealed that teachers' knowledge innovation was not only ineffective in boosting innovation behaviors among students, but it also exerted negative effects on students' creative self-efficacy and innovation behavior. Therefore, when promoting knowledge innovation, schools should prevent teachers from expending too much time on knowledge acquisition and neglecting their most crucial task—teaching—which would otherwise generate reverse effect. Schools should properly plan knowledge innovation for teachers, conduct evaluations and improvements and encourage teachers to attach equal importance to both knowledge innovation tasks and teaching.

**Examining the effects of general T and H department teachers and vocational and technical teachers on students' innovation capability**

Increase in the number of T and H departments in Taiwan has resulted in a shortage of T and H teachers. As a result, numerous schools employ vocational and technical teachers with relevant practical experience, believing that these teachers would be more helpful to improving students' practical skills. The investigation conducted in this study focused on only 30 general teachers and 13 vocational and technical teachers. The results indicated that vocational and technical teachers exhibited higher scores on students' creative self-efficacy and innovation behavior as compared with general teachers, but the difference was not significant. Therefore, this study recommends subsequent researchers to compare the effects of general teachers and vocational and technical teachers on students' innovation capability.

**Examining the effect of school innovation on students' innovation capability from multidimensional perspectives**

This study also recommends future studies to investigate whether school innovation for example, organizational innovation, innovative leadership, teaching innovation, or course innovation) is beneficial for enhancing students' innovation capability. In addition, the difference in effect among private and public schools can be examined. Alternatively, the effect of innovation activities in T and H department can be examined from student perspectives. Thus, more informative results regarding innovation can be provided as reference for schools.

**REFERENCES**


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